Introduction

- Patrick administration is committed to reducing GHG
- Vehicle Miles Travelled (VMT) contribute ~30% of GHG
- How much do people drive?
- How much can we explain driving habits using GIS data and analysis? In other words, are there spatial variables that correlate with how much people drive?

Science and data are important to achieving policy goals…

Strategies

- Technology – hybrids, biofuels, electric cars
  - Incentives and investments can accelerate adoption
- Economic – taxes, feebates, congestion pricing etc.
  - Politically difficult, even if revenue neutral
  - May unfairly impact low income populations
- Physical – smart growth - mixed use, mass transit
  - Also politically difficult, because of local land use control and antiquated zoning

Are there metrics for Smart Growth?

Does it work to reduce GHG?

Project design for statewide VMT analysis

Data & GIS Setup

Estimate annual VMT for each car / owner from inspection records over period 2005-2007

Geocode registered owner addresses
(problems with leasing, fleets etc.)

Integrate VMT and other data into analysis framework of 250 meter grid cells

Other Federal/state
- **Travel demand**
- **Census & DOT JTW**

Commercial license
- **Census population, households, income etc**
- **DNB business locations**

MassGIS
- **Land use to constrain demographics**
- **GIS mapping of institutions and other destinations**

Project design

Modeling

Use GIS to analyze relationship between household VMT and "smart growth" metrics

five D's (minus one) and an I

- ***density (housing, jobs)***
- ***destinations (regional access)***
- ***diversity (mix of land uses)***
- ***distance to transit***
- ***income***
- ***(we don't know how to map design!)***

5 D's from "Measuring the Effects of Land on Travel Behavior – D-factor Adjustments" presentation by Richard Lee/Fehr and Peers

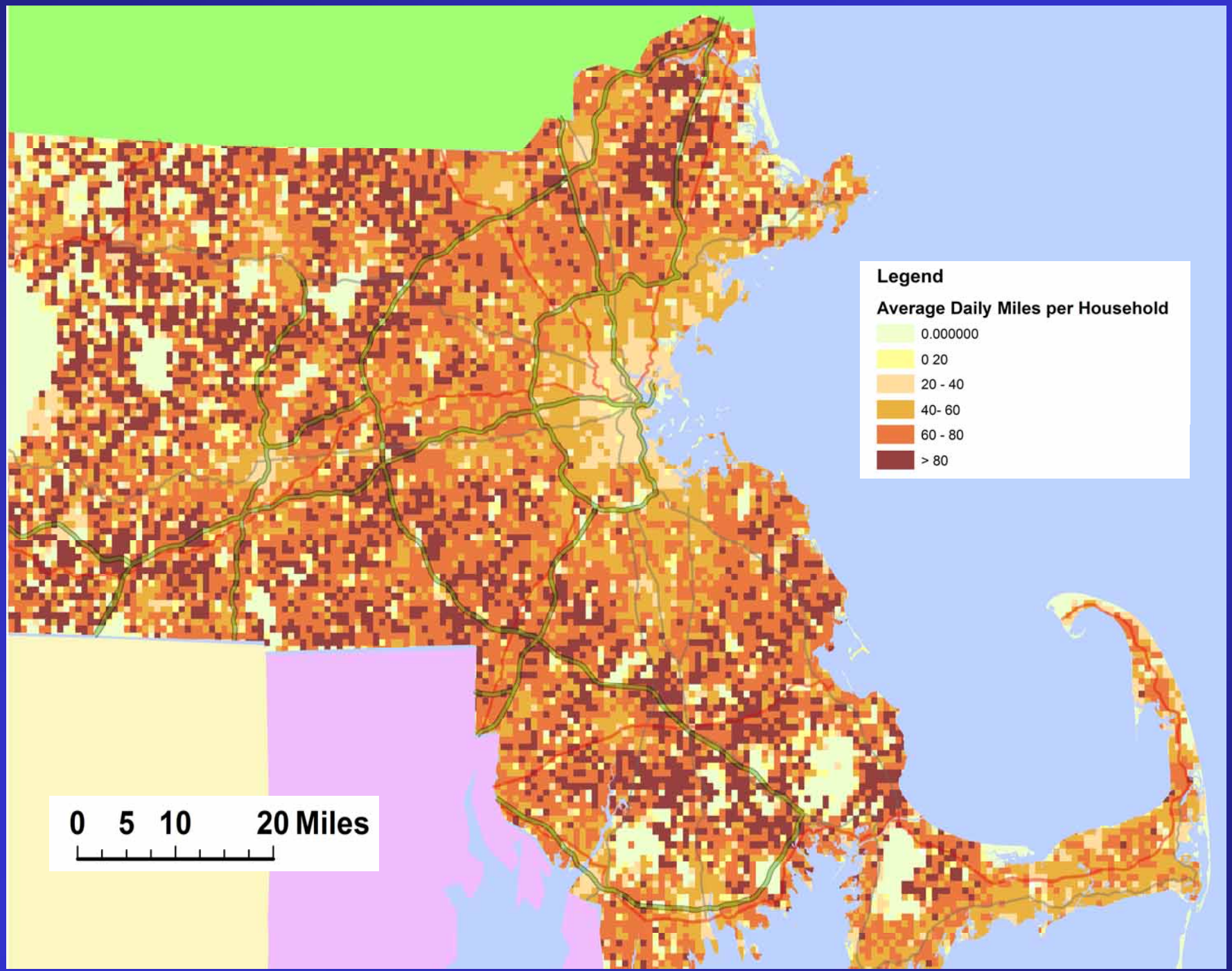
Again, see "Growing Cooler: The Evidence on Urban Development and Climate Change" Urban Land Institute

How much do people drive?

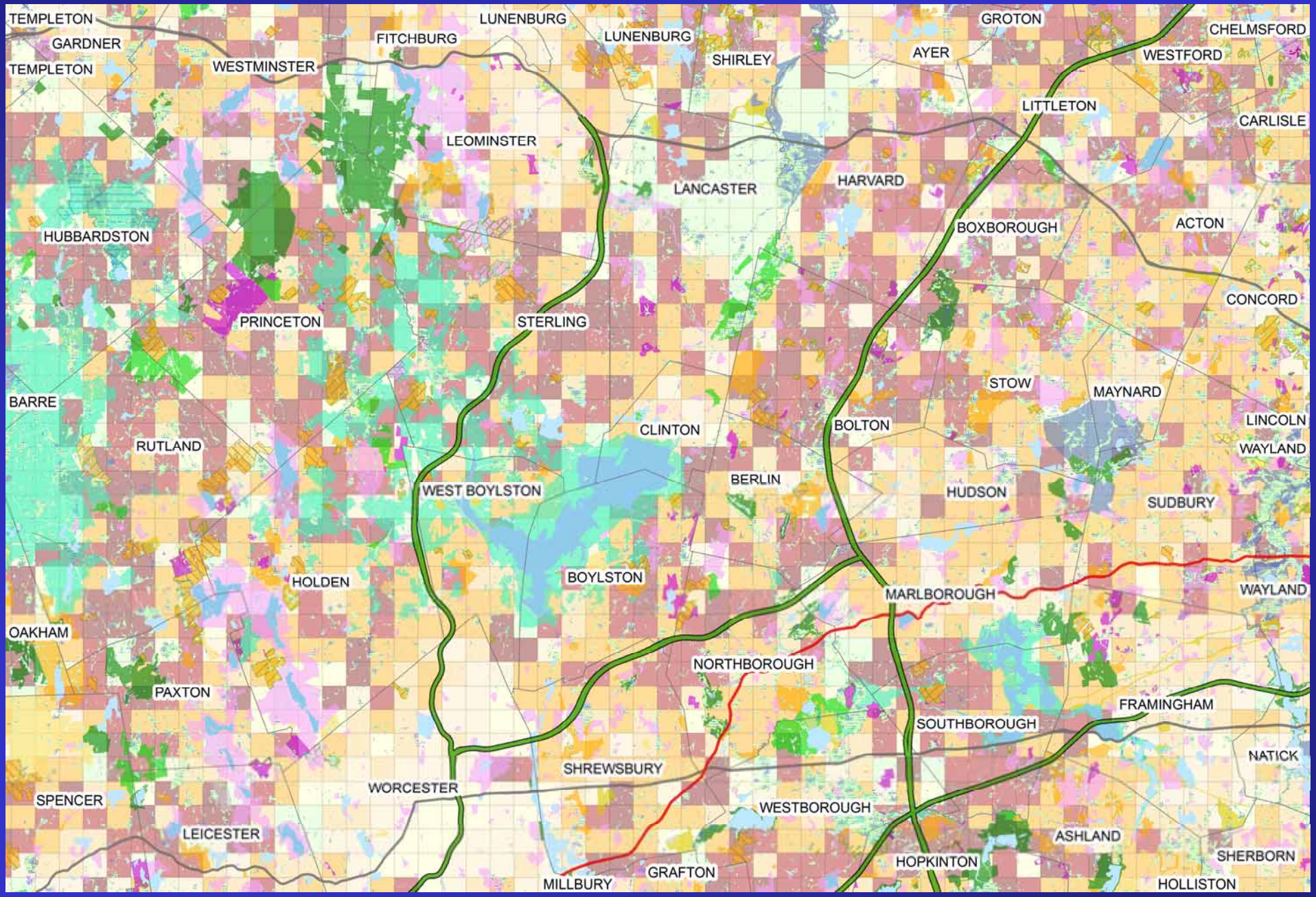
- 16 million inspection records for 4.5 million vehicles
  - Registration number (license plate)
  - Registration type (passenger, hearse, bus, truck etc.)
  - Vehicle Inspection Number (need VIN decoder ring!)
  - Make, Model
  - Gross Vehicle Weight category for heavy commercial vehicles
  - Owner address (both residence and mail address provided)
  - Town where principally garaged
  - Odometer reading
  - Date of Inspection

- Two successive inspections with same plate give estimate of annual miles on that car for that household

Daily VMT/HH from RMV mapped to HH address



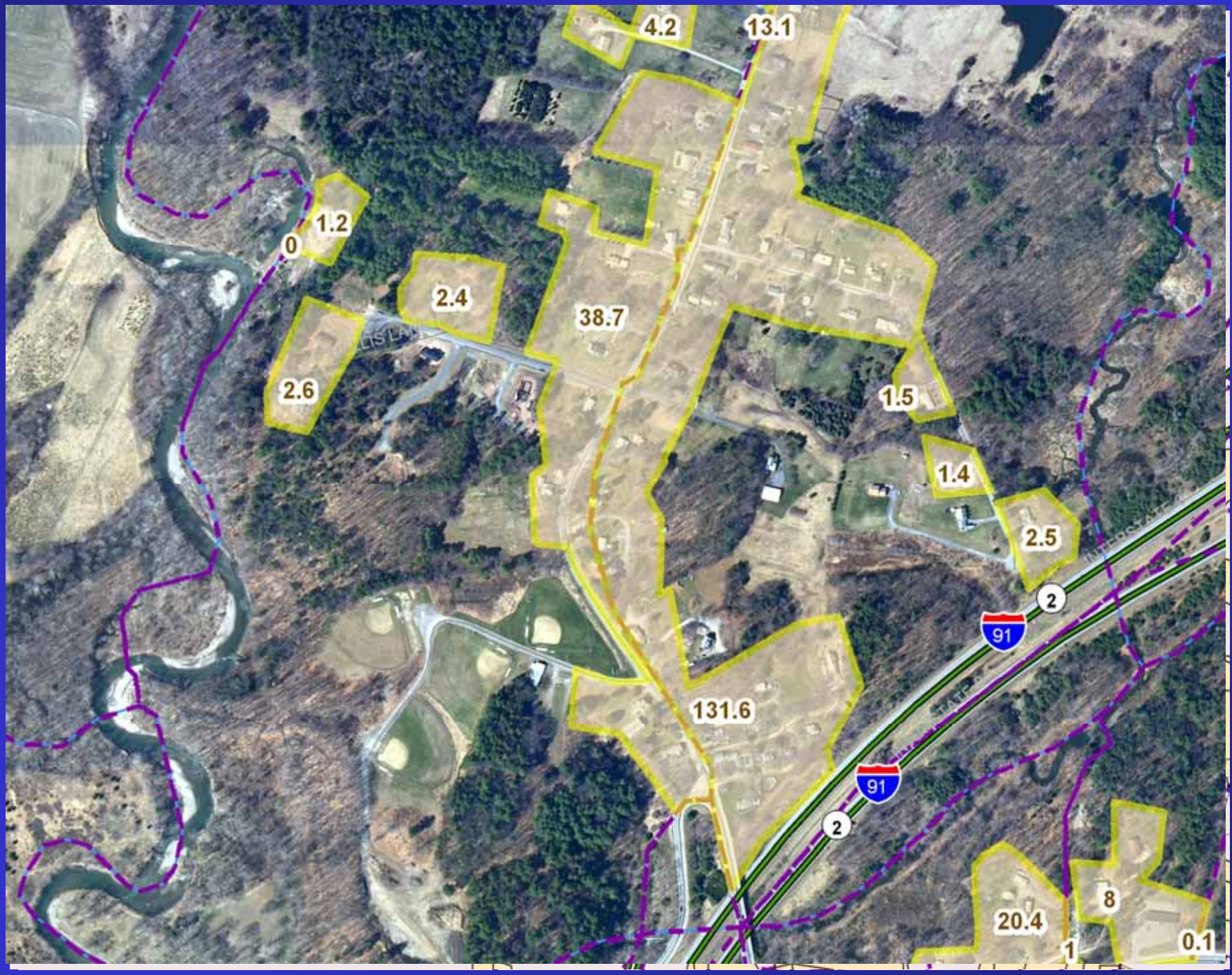
Why is there so much “noise”?
- wetlands and water bodies, open space etc.



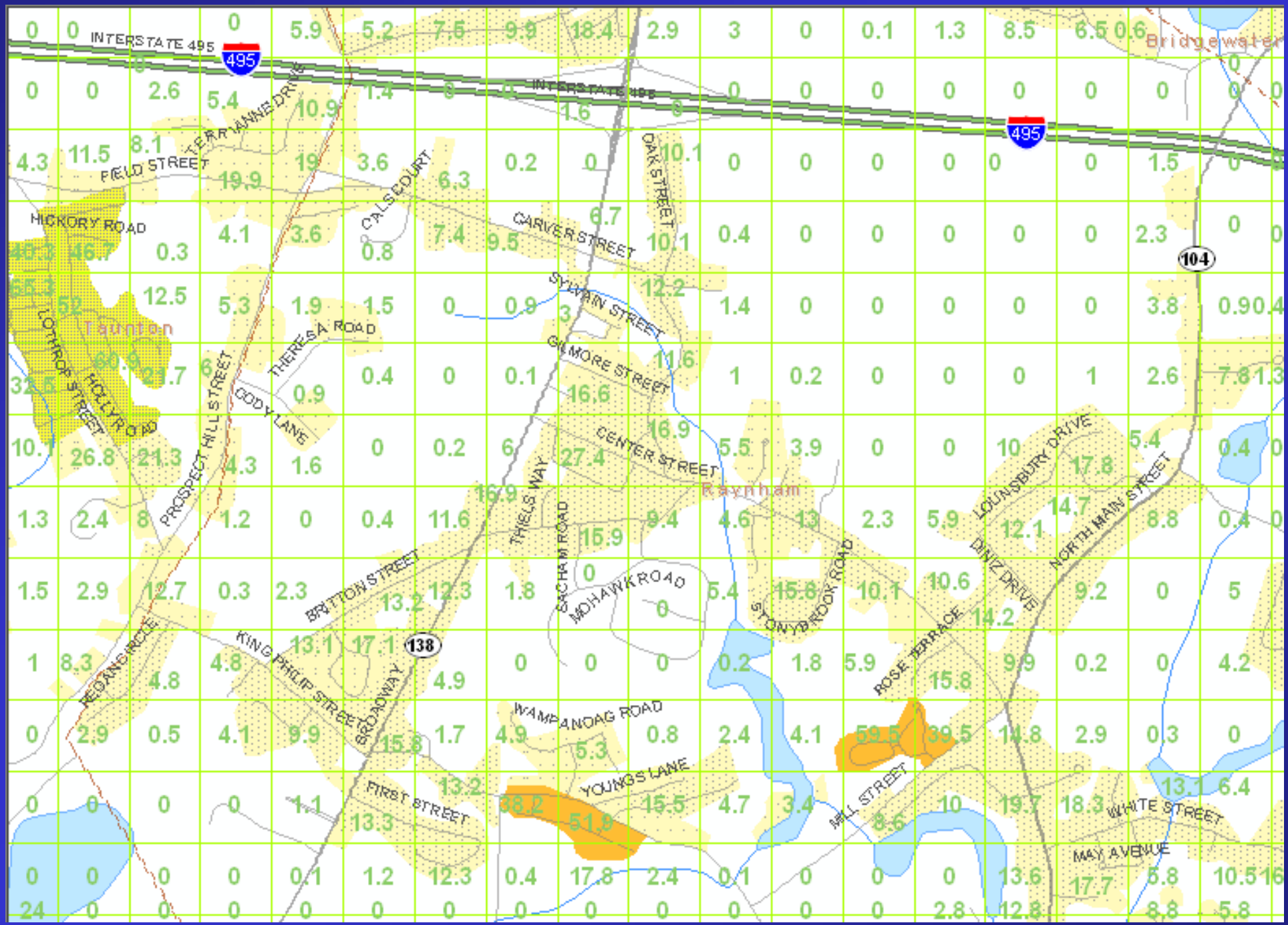
Exactly where do people live?
How do we measure household density?

- We can estimate where people live and calculate household density from Census, but …
  - Blocks and block groups can be quite large and we don't know *where* within them people live
  - Data are nine years old
- Land use mapping outlines residential areas precisely, but …
  - Density of residential categories varies
  - Newer land use data don't match Census in age
- Solution…
  - Combine data to get accurate geography for counts
  - Use land use and Census data from same time period
  - Update counts with RMV addresses where necessary

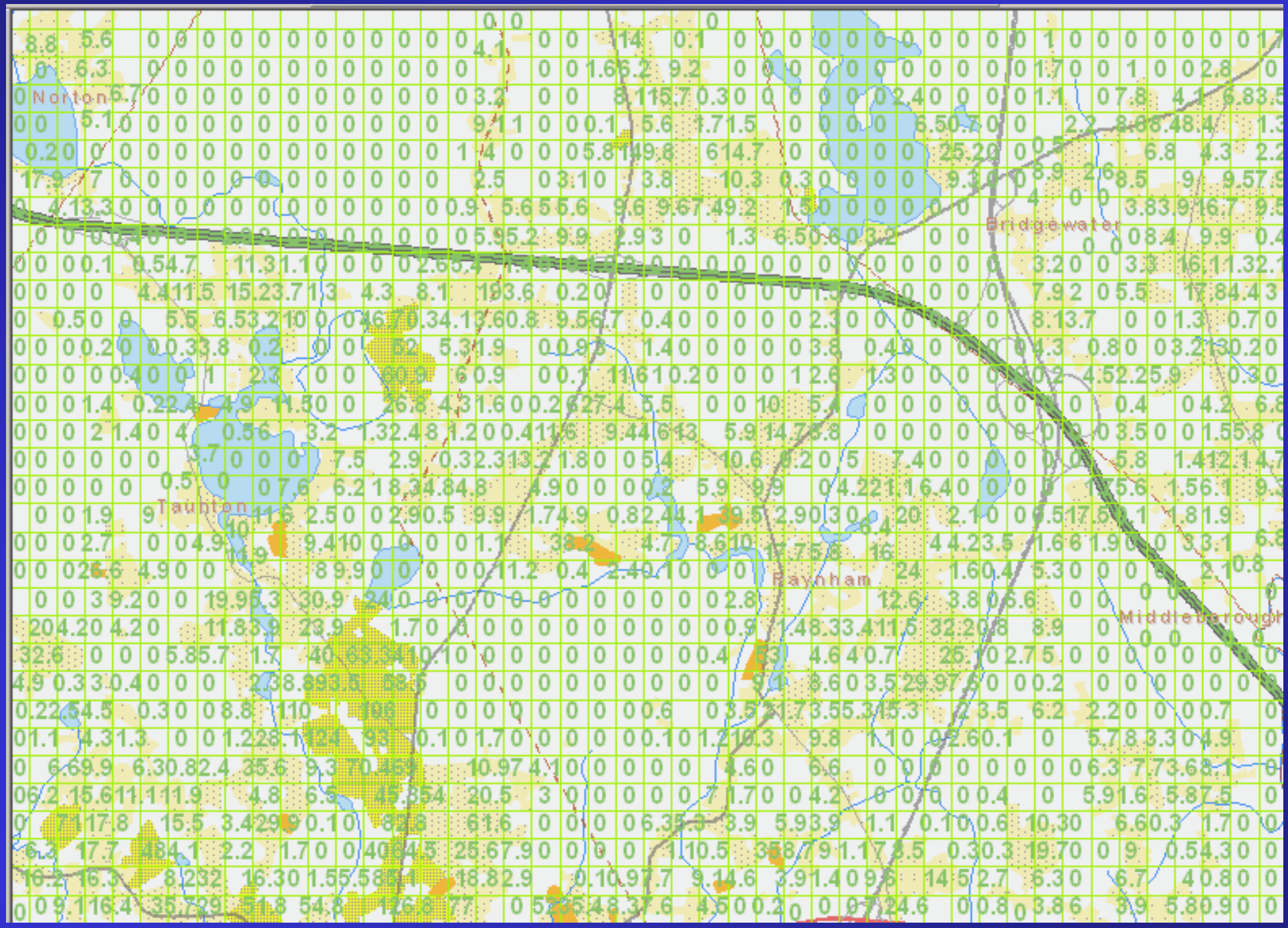
Developing true population density measures



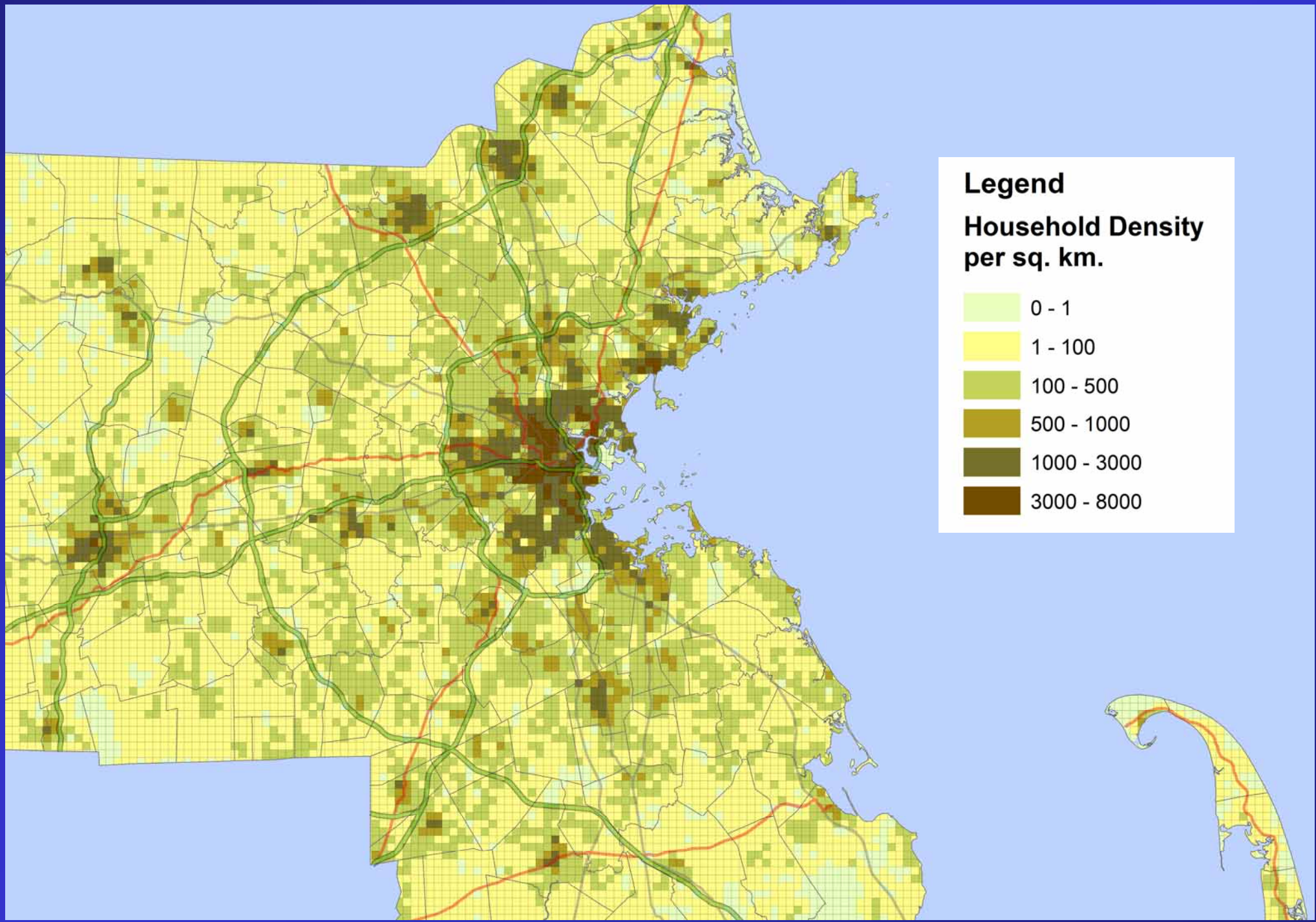
Grid cell representation



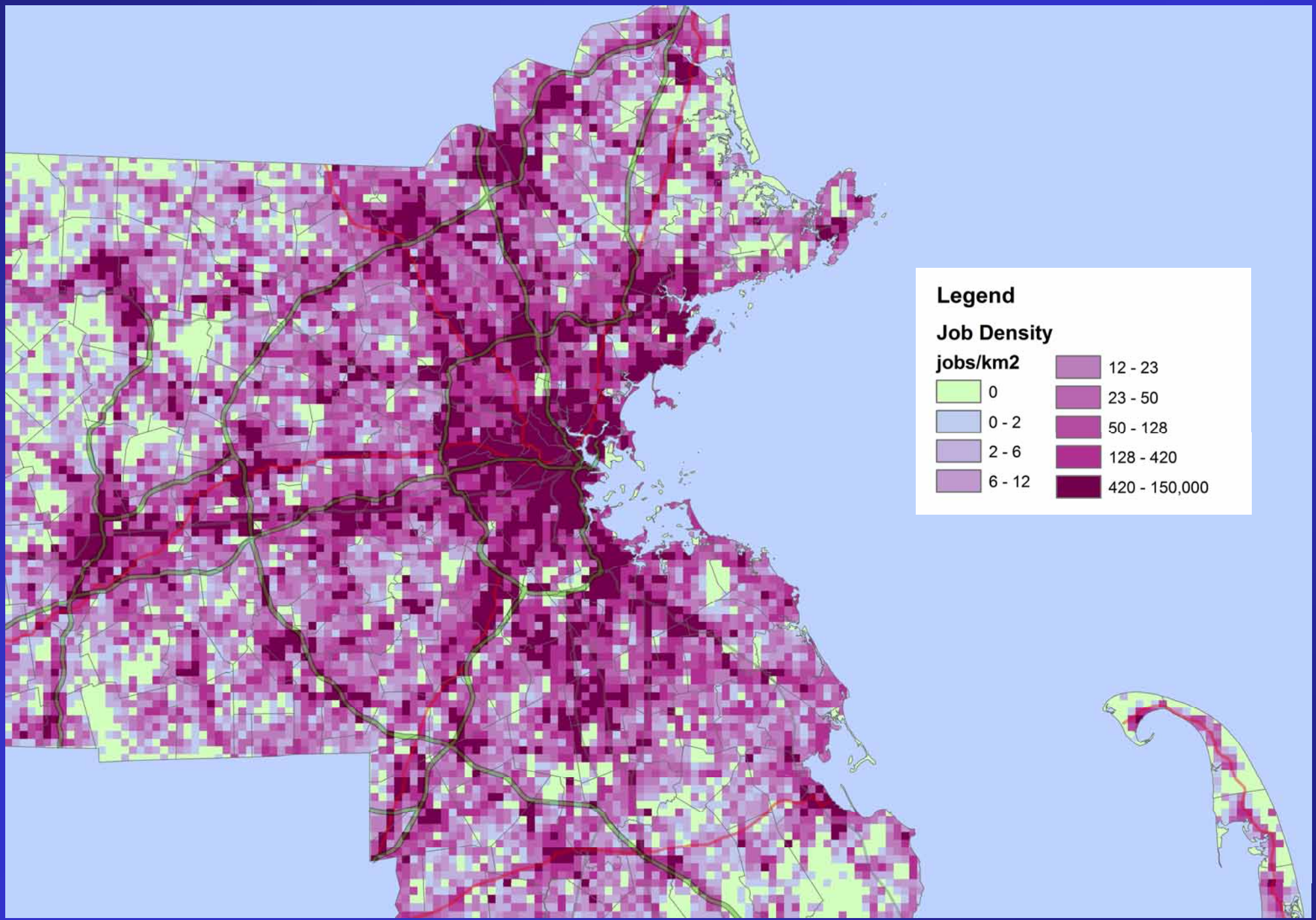
Zoom out ...



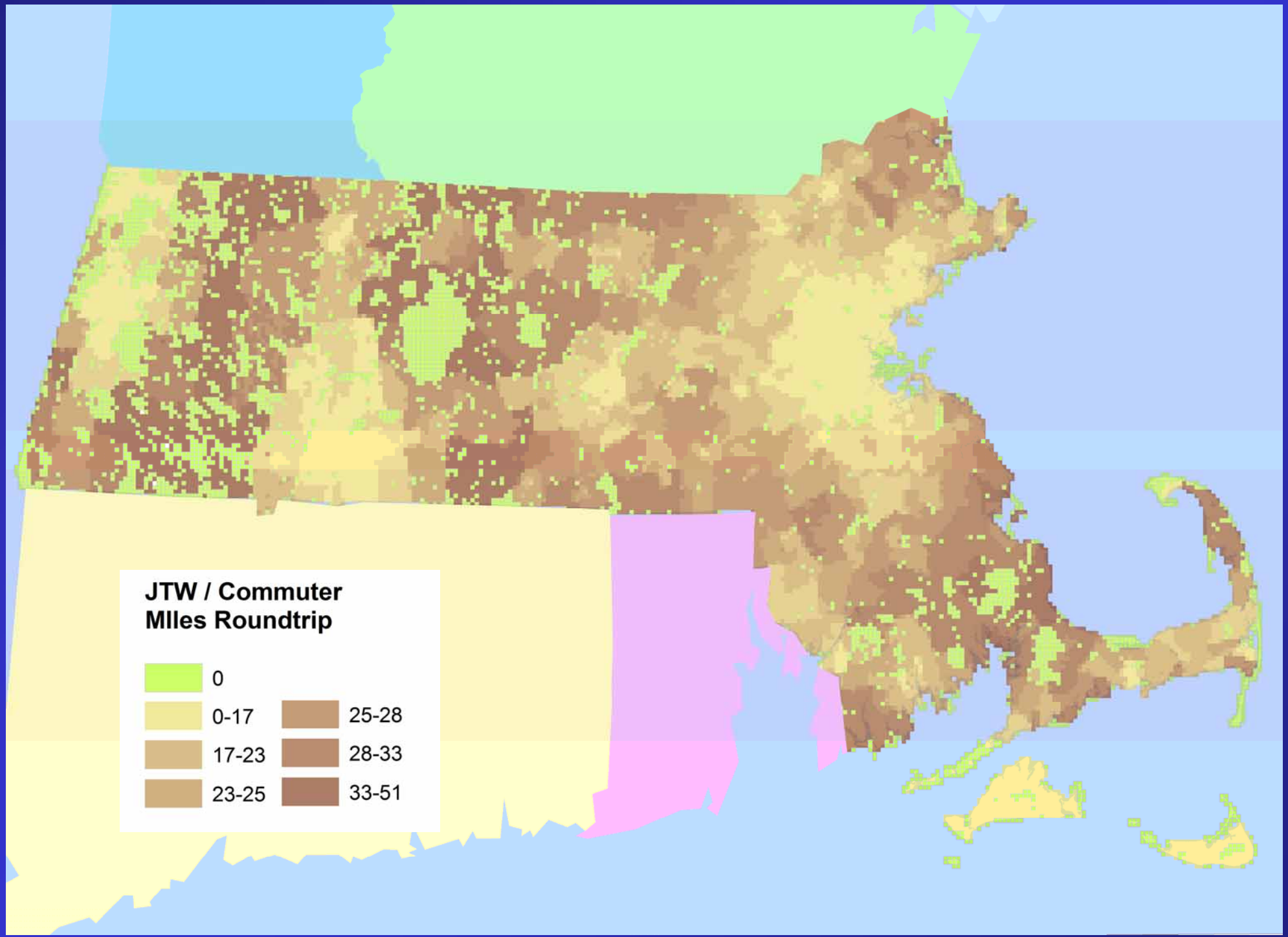
Household density



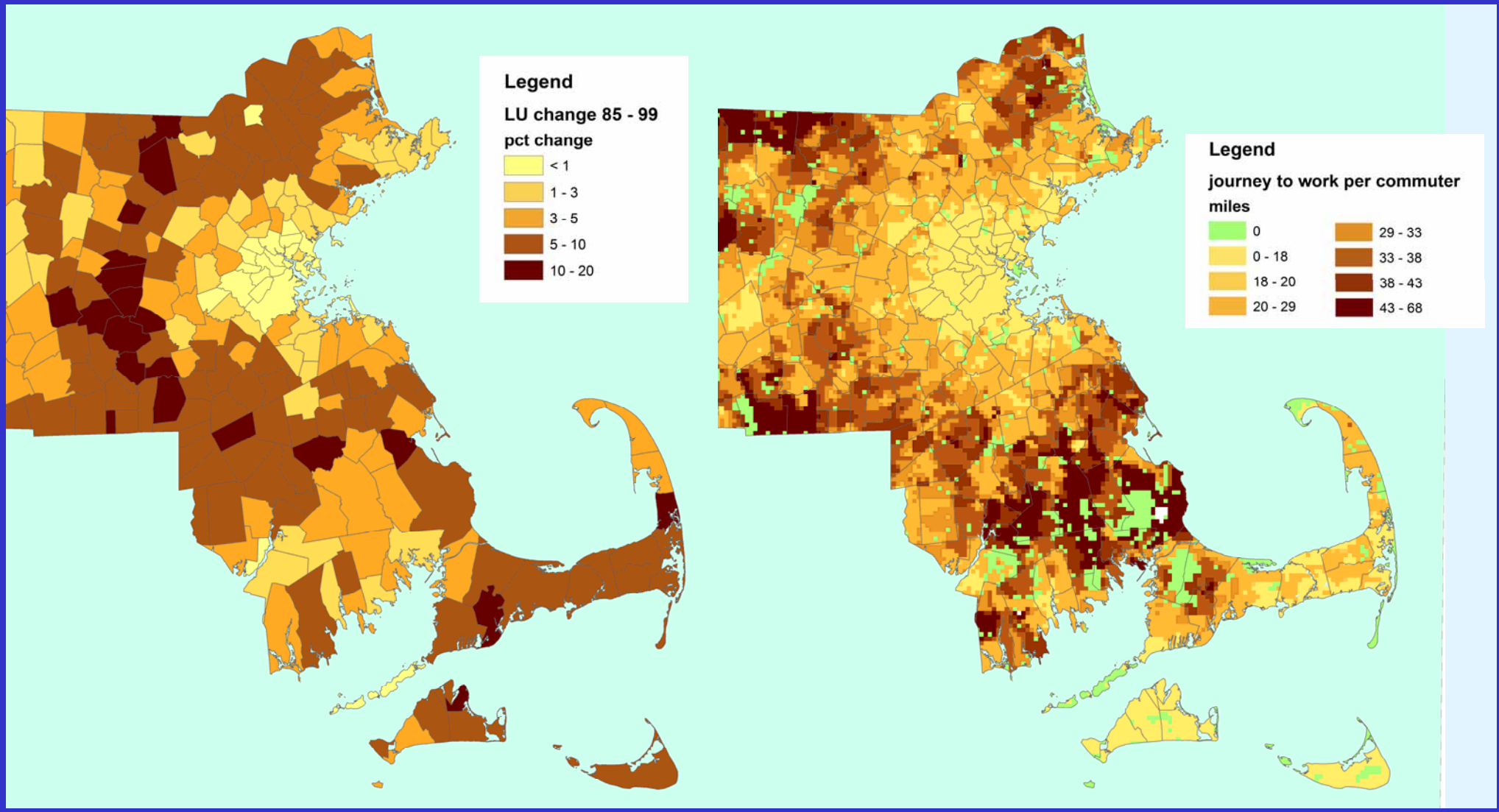
Job Density


Legend
Job Density
jobs/km2
0
0 - 2
2 - 6
6 - 12
12 - 23
23 - 50
50 - 128
128 - 420
420 - 150,000

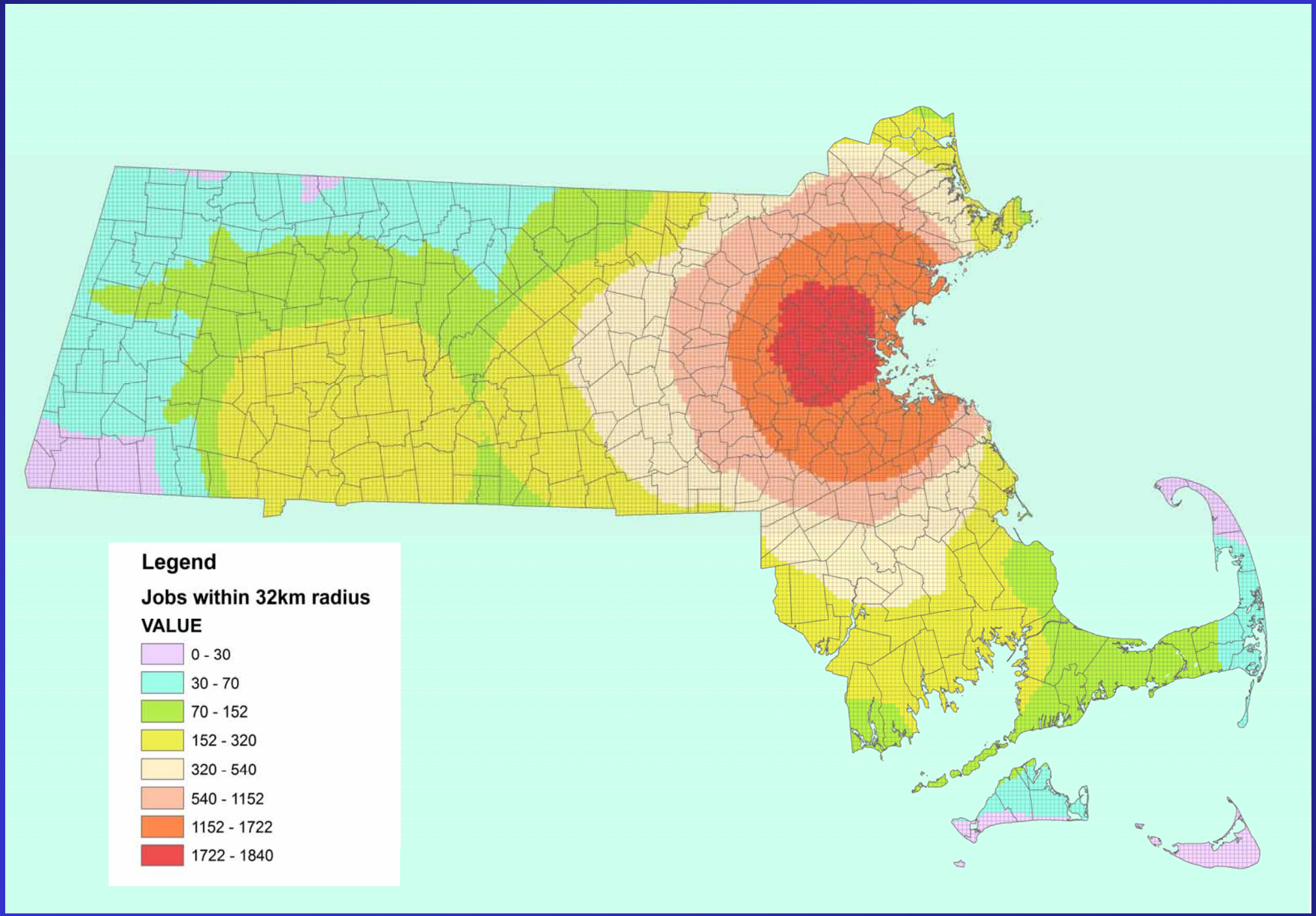
Data on JTW from Census and FHWA



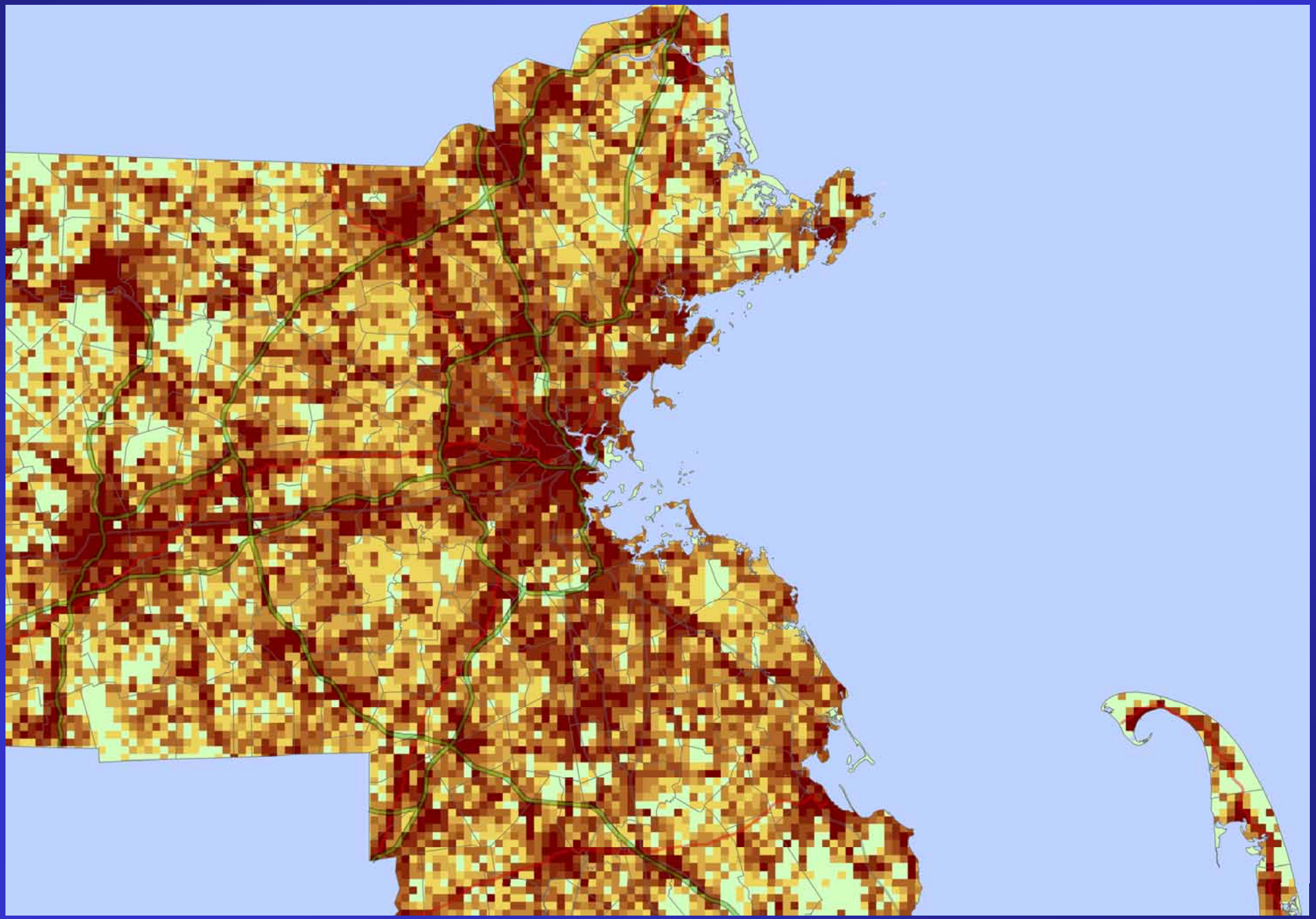
Do patterns of land use change help explain journey to work figures?



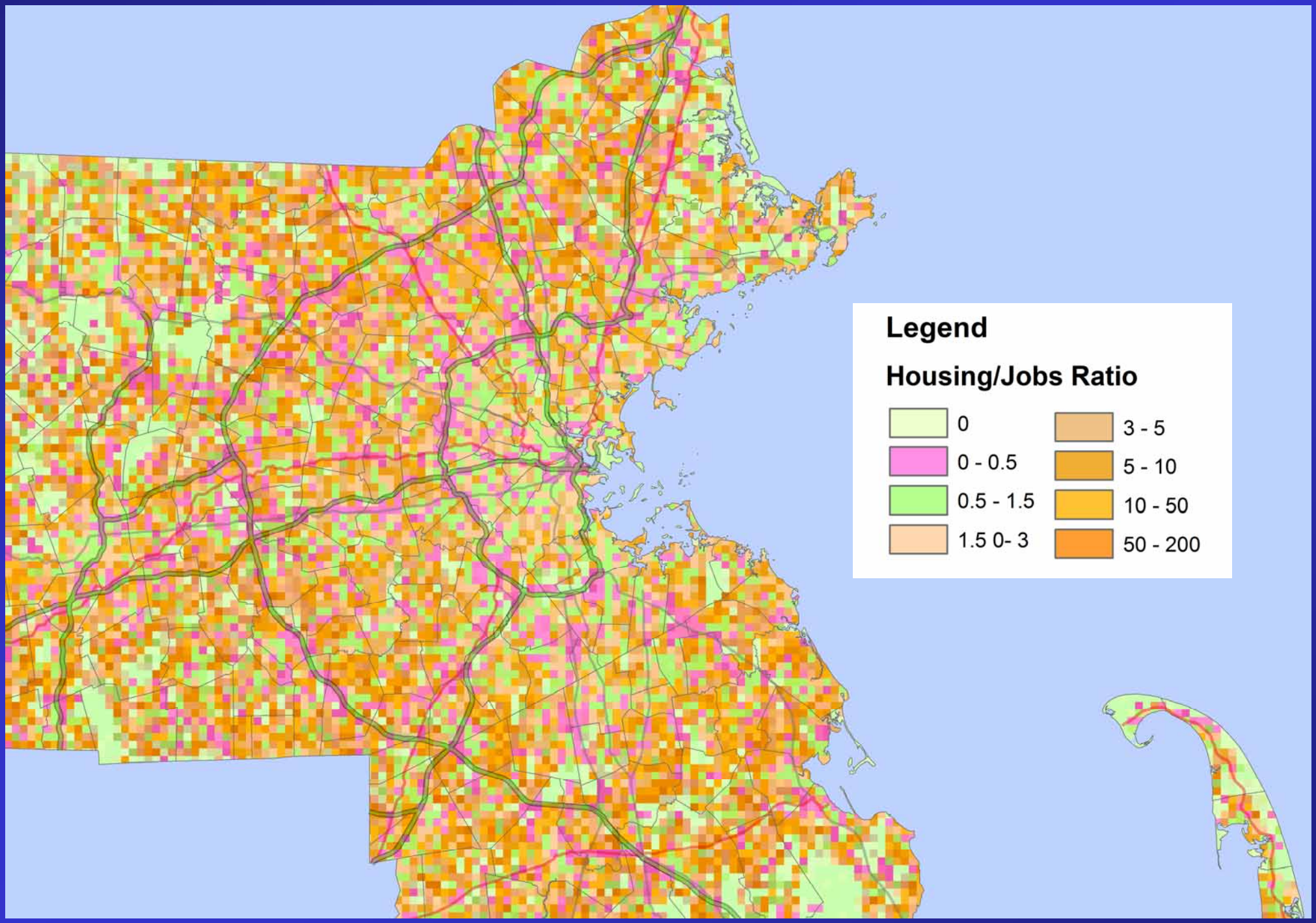
Access to jobs



“Relative” Job Density -- Simplistic Model



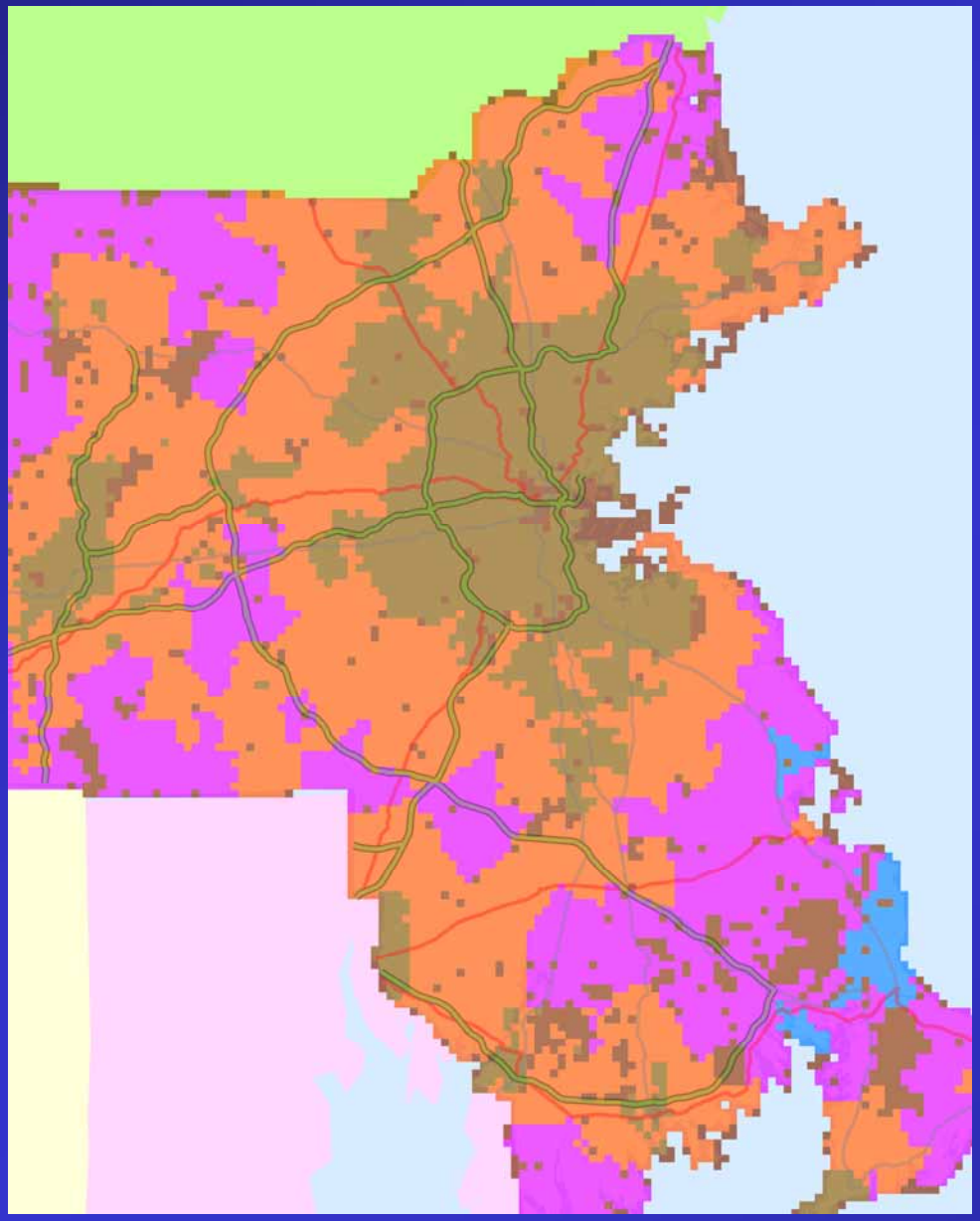
Housing divided by jobs



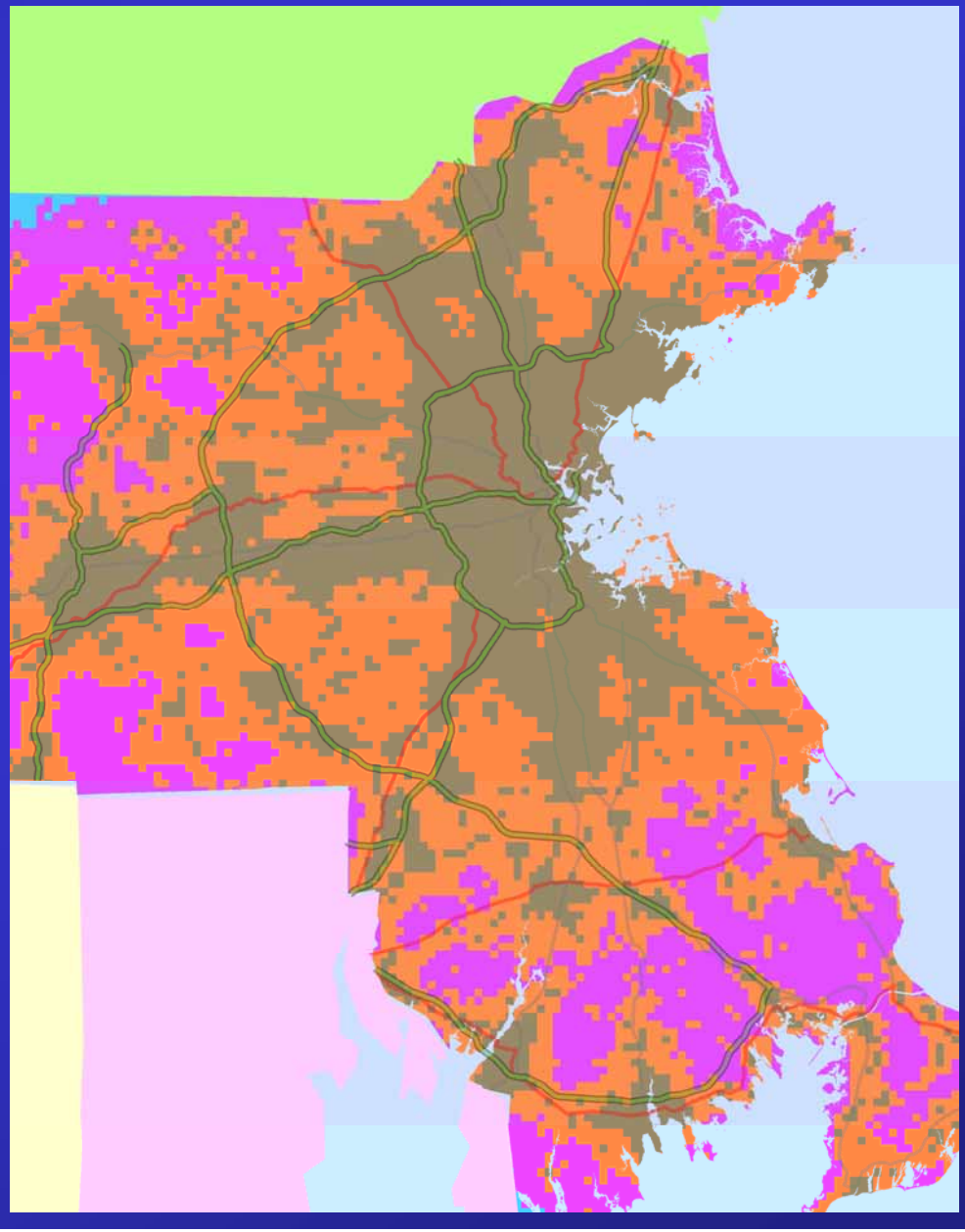
JTW from jobs & HH

$$c = \Sigma_{i,j} \frac{J}{H * d^{0.65}}$$

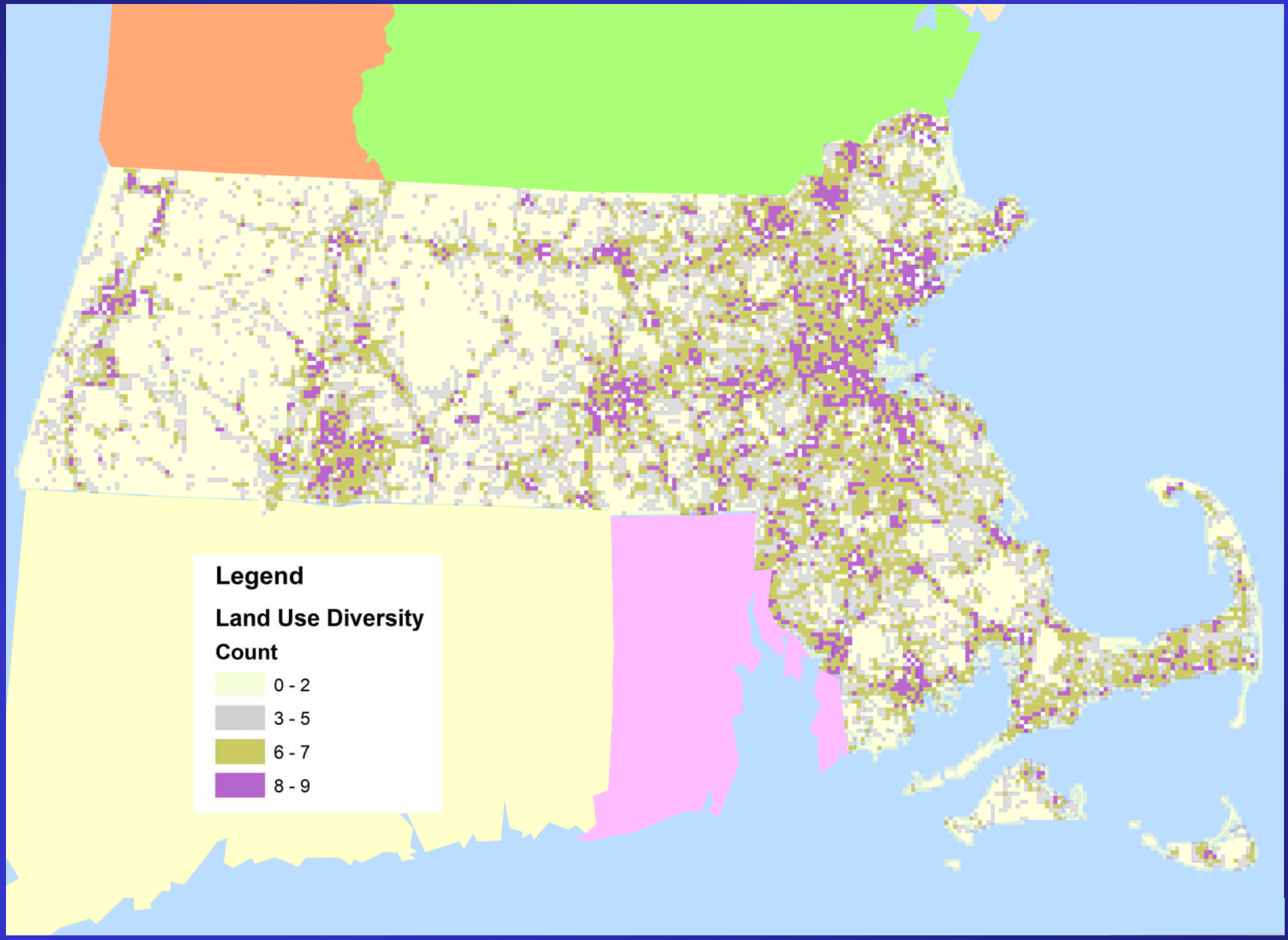
Data - JTW FHWA/census



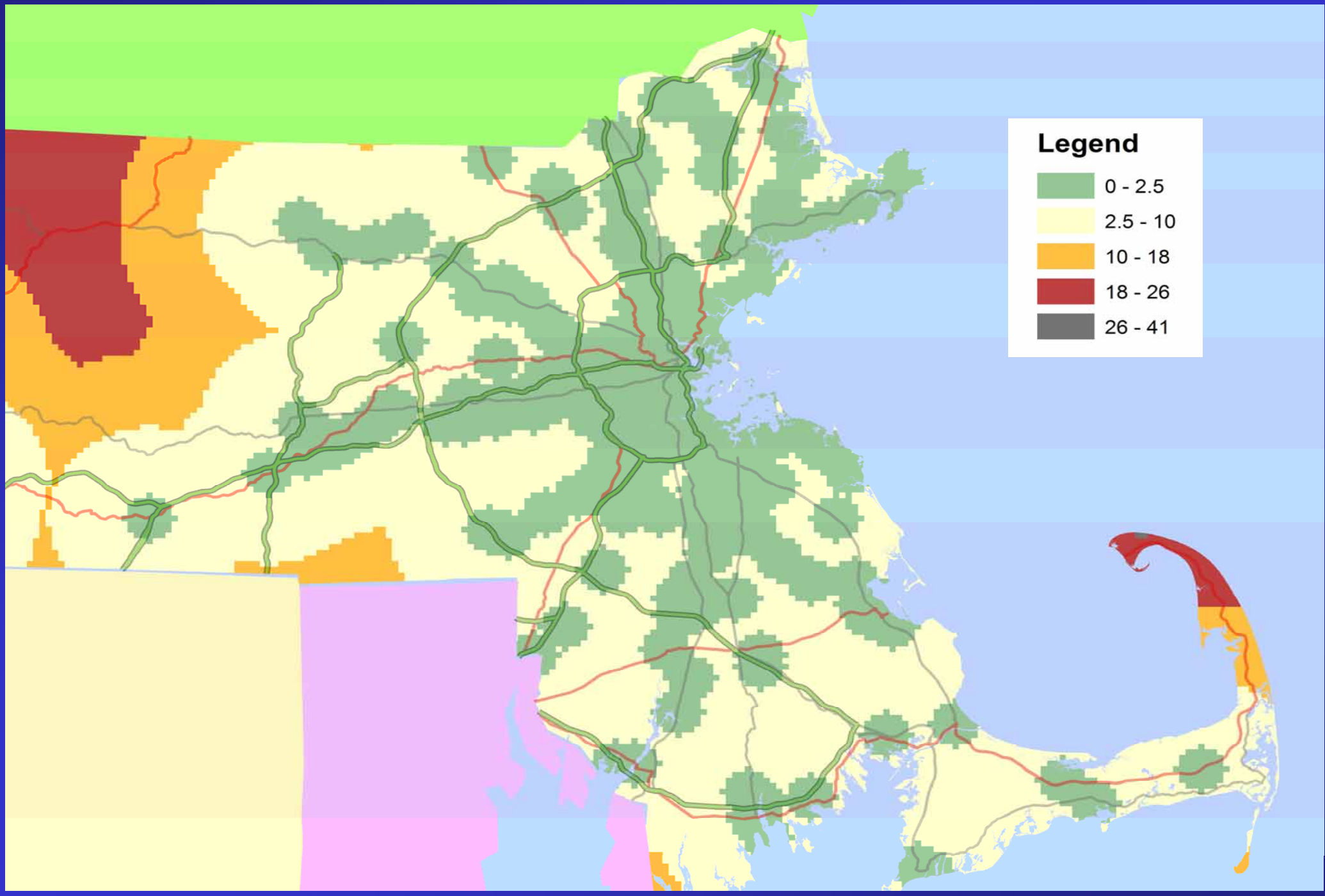
Model - access to jobs



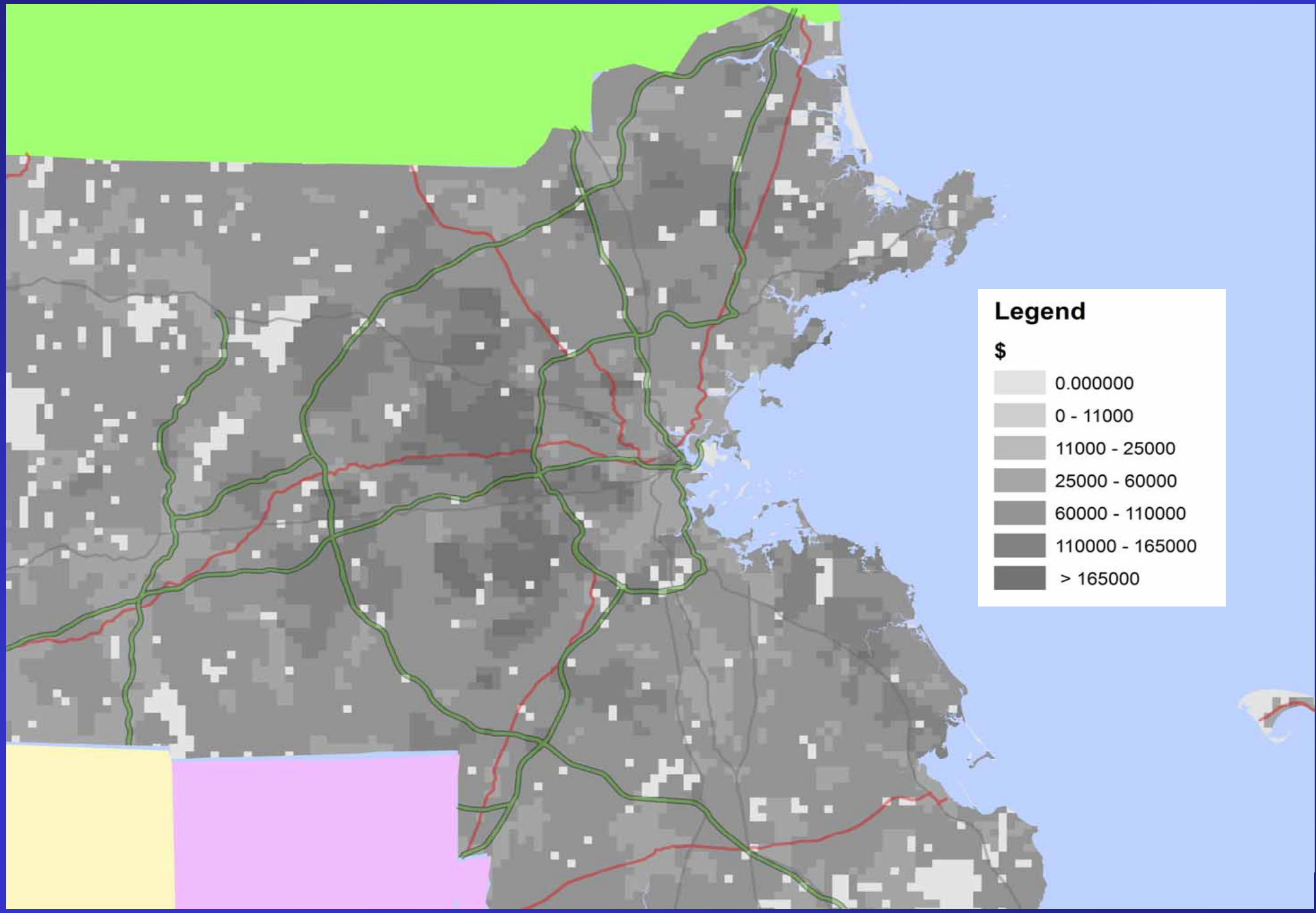
Land Use Diversity



Distance to transit



Median Household Income



Regression model – 4 D's are significant

- From dataset of 13,000 km^2 cells statewide with measured household density, diversity of land use and level of development, income and modeled access to jobs, we randomly sampled 600 cells for regression analysis (all variables continuous)
- Plot and regress pairs, use generalized additive models and tree model of all variables to refine a multivariate regression model
- All six variables (two related to land use) were highly significant in the following initial model for VMT

Household vehicle miles =

$$84 - 0.9 * Household\_density^{0.5} - 0.8 * Job\_access^{0.2} - 0.58 * Distance\_to\_transit - 1.25 * LU\_diversity + 5.6e\text{-}05 * Household\_income + 14 * Percent\_cell\_developed$$

This model explains about half of the variance in daily miles per household.

Points for review and future directions

- Issues with statistical analysis
  - Correlation of inputs
  - Non-constant variance
  - Sampling methodology
- Use VINs to derive profile of fleet fuel economy
- Look at trends in future datasets from RMV

Pair-wise Relationship between Household VMT and Household Density